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Research Briefs

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Inside

- Tracking pesticide residues in food will be much faster with new extraction techniques.—p. 3.
- Fatal indigestion isn't the latest thriller movie, but could be a killer scenario for crop pests.—p. 4.
- Scientists look to tobacco juice or a color change to outsmart crop-devastating whiteflies.—p. 4.
- A common dietary supplement in Japan may rejuvenate older people's immune response.—p. 2.
- Consuming too much refined fructose may aggravate the effects of getting too little zinc--much the same as it does with copper.—p. 2.
- Chicken genes are being put on the map--a first step toward custom-designed poultry.—p. 3.

Nutrition and Health

Eating alone is the most common factor behind poor nutrition among older people. That's according to a survey of nearly 700 volunteers from age 60 through their 90's--the latest of several studies to show this association. Other factors identified that contributed to poor nutrition, in order of their impact, were low education level, belonging to a racial minority, living in a low-income neighborhood, smoking, wearing dentures and taking multiple medications. To determine these factors, researchers ran statistical analyses on the survey volunteers who reported diets that met one or more of the following criteria: less than two-thirds of the Recommended Dietary Allowances for calories, vitamins or minerals; more than 40 percent of calories from fat; or more than 15 percent of calories from saturated fat. A low-calorie intake was the most frequent deficit among the women and was linked to eating alone, belonging to a racial minority and taking multiple medications. A high-fat or high-saturated-fat intake was the main liability among the men and was linked to eating alone, low education level and smoking. Smoking was also associated with a high-fat intake among the women.

Human Nutrition Research Center on Aging at Tufts Boston, MA

Katherine Tucker, (617) 556-3351

Our bodies absorb and use more members of the chemical family known as carotenoids than just beta carotene. And some of beta carotene's relatives may be just as important in preventing cancer due to their anti-oxidant capability, according to analyses of human blood. Just three years ago, only seven carotenoids had been found in human plasma. ARS research has identified 12 more, some of which are oxidation by-products of two commonly eaten carotenoids--lutein and zeaxanthin. The fact that they become oxidized themselves into benign compounds indicates they can protect cell molecules, including DNA. This supports the hypothesis that the anti-cancer potential of carotenoids is due to this anti-oxidant capability. Population studies have linked a high intake of fruits and vegetables rich in carotenoids with a lower risk of cancers of the lung, esophagus, colon, head and neck. These red, orange and yellow pigments give tomatoes, carrots and squash their distinctive colors. They're also abundant in dark green, leafy vegetables, but are hidden by the green of chlorophyll. *Beltsville Human Nutrition Research Center, Beltsville, MD Frederick Khachik, (301) 504-8830*

Methods for measuring fiber in foods are far from foolproof--despite the new labeling requirement that total dietary fiber be listed on foods containing more than one gram per serving. An ARS chemist compared the method currently approved by the Association of Official Analytical Chemists (AOAC) with her own simplified method on both cooked and canned legumes. For the canned legumes, the two values were similar. But they differed two-fold for cooked legumes. Cooked chick peas, black beans, Great Northern beans, kidney beans and pinto beans had half as much fiber when measured by the simpler ARS-developed method. That's because some hard-to-dissolve starch remained in the samples prepared by the AOAC-approved method--giving a false high reading for fiber. This "resistant starch," however, dissolves at the higher temperatures used in canning so that these values from both methods agree. The study was prompted by the National Cancer Institute's request for more complete data on the fiber content of legumes, which are second to whole grain foods as an important source of fiber. Among the 17 different store or national brands analyzed by the simplified method, total dietary fiber ranged from 16 percent for chick peas and canned pork and beans to 29 percent for lima beans and kidney beans cooked at home.

Beltsville Human Nutrition Research Center, Beltsville, MD Betty W. Li, (301) 504-8466

Supplements of glutathione may boost older people's flagging immune response, according to preliminary findings. The anti-oxidant glutathione--one of the most abundant simple peptides in humans and other living organisms--is a common dietary supplement in Japan but not in the United States. This researcher had earlier shown that another anti-oxidant, vitamin E, helps restore older people's ability to nip germs and would-be cancers in the bud. She wanted to see if extra glutathione could also improve the function of white blood cells, especially T-cells, where most of the age-related loss of immune response occurs. So she tested the peptide first in aging mice with successful results and then on white blood cells from both young and older people. Glutathione improved the cells' ability to divide and to produce substances that mobilize other players in the immune response. It also dampened the cells' production of inflammatory substances. And it had a greater effect on the more sluggish cells from the older people, boosting their function close to that of young people's cells. This researcher now wants to test glutathione supplements in a human study.

Human Nutrition Research Center on Aging at Tufts Boston, MA

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By restricting rats' food intake, researchers again reduced the tissue damage and premature death caused by copper deficiency. This study, done at Beltsville, MD, and another reported last quarter from Grand Forks, ND, have uncovered another benefit of cutting calories. Normally, when young male rats are fed a copper-deficient diet containing high levels of sugar, they suffer damage to the heart and pancreas, become anemic and die prematurely. By reducing the food intake of growing male rats to the amount their female counterparts normally eat, the Beltsville scientists significantly reduced the symptoms of copper deficiency and kept all the rats alive during the 10-week study. It is very difficult to conduct food restriction studies in people. But scores of such studies in test animals over several decades have prevented cancer and other age-related diseases as well as doubled the animals' life span.

Beltsville Human Nutrition Research Center, Beltsville, MD
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Does a high intake of fructose sugar magnify the consequences of a low-zinc diet as it does for a low-copper diet? In rats' brains, at least, the answer is yes. A low-zinc diet is already known to alter the function of natural chemicals known as opiates that have hormone-like effects in human and animal brains. So ARS researchers studied the combined effects of a high-fructose, low-zinc diet on opiate receptors. The animals raised on a marginal zinc diet containing no fructose showed some change in the receptors. But the group raised on marginal zinc and high fructose showed much greater changes. By contrast, the groups that got adequate zinc had normal receptors,

regardless of whether they got fructose or starch as the carbohydrate. Comparatively speaking, Americans ingest much less fructose than contained in these diets. And most get enough zinc. But the findings illustrate how table sugar and sweeteners--which are steadily increasing in the U.S. diet via processed foods and beverages--can interfere with the body's use of other nutrients. Table sugar is one-half fructose; high-fructose corn sweeteners are about 55 percent fructose.

Beltsville Human Nutrition Research Center, Beltsville, MD
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Eating fish every day of the week can be too much of a good thing, over time. A study shows it has the potential to depress immune function, leaving people more vulnerable to infections. Researchers put 22 volunteers on a low-fat diet (30 percent fat calories) for nearly six months. Half got most of their polyunsaturated fats from eating fish--tuna, salmon or filet of sole--at least once a day, while the other half got them from vegetables. By the end of the study, the fish eaters had a 46 percent weaker response to a skin hypersensitivity test, compared with their response at the beginning of the study. And their T-cells were 24 percent slower to multiply when challenged with a substance that promotes cell division. And some of the chemical signals that orchestrate a coordinated immune response were also significantly depressed. By contrast, the vegetable fat group had a significant increase in these chemical signals, compared to their initial test results, as well as an increase in specific lymphocytes. This runs counter to results of animal studies in which vegetable-derived polyunsaturated fats tended to suppress immune function. The findings should not discourage people from eating fatty fish several times a week as recommended. But those who eat an excess would be wise to get adequate levels of anti-oxidant nutrients, such as vitamin E and beta carotene, to counter the effects of fish oil.

Human Nutrition Research Center on Aging at Tufts Boston, MA

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Tracking molybdenum levels in the body may be easier now that ARS scientists have identified two promising analytical procedures. Body enzymes use molybdenum to prevent toxic buildup of certain chemicals and to aid normal fetal development. One technique relies on enzymes; the other uses a special form, or "isotope," of the mineral. In the future, either of the two approaches might be incorporated into a simple urine test that physicians and nutritionists could use as part of a patient's nutrition check-up. Beans, peas and whole grains are the best sources of this little-known but essential mineral.

Micronutrients Research, San Francisco, CA
Judith R. Turnlund, (415) 556-9697

Tomorrow's Foods

Shrinking excess fat from broiler and roaster chickens would be welcome news for health-conscious consumers. ARS scientists have targeted a hormone called pancreatic polypeptide, which they believe changes the ratio of proteins in cells to stimulate the breakdown of fat. Preliminary results suggest it may be possible to eventually identify the genes responsible for accumulating excess fat in chickens. This could lead to genetically engineering chickens to produce less fat. Getting rid of excess fat in the birds' abdomens, for example, could save farmers \$500 million in feed annually.

*Poultry Research, Georgetown, DE
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To speed development of poultry for selected traits, researchers are making a genetic map of the chicken. So far, more than 220 DNA segments known as genetic markers have been placed on the map. Genetic markers, like mile markers along a highway, allow scientists to more accurately pinpoint the location of genes that control valuable traits such as disease resistance or meat quality. Markers lie at intervals along 39 pairs of chromosomes in the chicken. The major project goal is to map 100 to 200 evenly spaced genetic markers that can be easily used to find genes for agriculturally important traits. About 30 of these "landmark" genetic markers have been discovered. When the map is completed, poultry breeders will have the ability to know precisely where to check on the chromosomes for the presence of genes that control specific traits as well as know which birds possess the desired genes.

*Avian Disease and Oncology Research, East Lansing, MI
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Two new strawberry varieties--Redgem and Bountiful-- are available in season from some Pacific Northwest nurseries. Berries from both plants keep their original color, texture and shape after thawing, making them ideal for use in either frozen or processed foods like ice cream, frozen pies or yogurt. Other advantages of the developed varieties: Redgem may appeal to backyard gardeners and local fresh-market growers in Oregon, Washington and Idaho. Bountiful is a candidate for mechanical harvesting because most of its berries can be gathered with only two harvests compared with three or more pickings needed for most commercial strawberry varieties. Last year, Pacific Northwest growers harvested 72 million pounds of strawberries, worth about \$26 million.

*National Clonal Germplasm Repository, Corvallis, OR
Francis J. Lawrence, (503) 750-8712*

Scientists have discovered master genes, known as homeobox genes, that should open the door to new designs for crops. Such a gene contains a section--the homeobox--

that controls other genes. ARS scientists found the first homeobox gene in corn and then identified similar genes in other plants. Researchers elsewhere have used the homeobox from the corn gene to isolate homeobox genes in other crops, including rice, tomatoes, barley and peas. Scientists hope to use the genes to uncover secrets about plant growth. The new knowledge could lead to ways to drastically change a plant's architecture and perhaps boost yield. One possibility: corn plants with short, squat stalks that can support more ears than today's tall, slender cornstalks.

*Plant Gene Expression Center, Albany, CA
Sarah C. Hake, (510) 559-5900*

Food Freshness and Safety

New lab procedures can extract many pesticide residues from food samples in minutes instead of hours. Many current methods require an entire day and large amounts of hazardous solvents. But the new ARS-developed procedures take only five minutes and use small amounts of water or other safe solvents. Lab analysts have used the procedures with commercial ELISA kits to detect the herbicide alachlor and the insecticides aldicarb and carbofuran in milk, meat, liver and eggs at the 10-to-50 parts-per-billion tolerance levels set by the U.S. Environmental Protection Agency.

*Environmental Chemistry Laboratory, Beltsville, MD
Steve J. Lehotay, (301) 504-8904*

Harvested apples, pears and other fruits that are protected from molds and rots by naturally occurring yeasts rather than chemical fungicides are a step closer to the market. ARS has entered into a cooperative agreement with EcoScience Corp. of Worcester, MA, to develop this technology for commercial use. ARS researchers identified and received a patent for a naturally occurring yeast, *Cryptococcus laurentii*, that fends off two molds and a rot that leave fruit soft, smelly and watery. EcoScience researchers are exploring opportunities for mass-producing and marketing this yeast or other helpful microbes for use on fresh produce. That could cut losses from decay and reduce or eliminate the need for spraying fruit with chemical fungicides.

*Tree Fruit Research Laboratory, Wenatchee, WA
Rodney G. Roberts, (509) 664-2280*

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Processed orange juice can now taste more like freshly squeezed juice, thanks to a new computer program that pinpoints the precise mix of flavor components that make up an orange's fresh taste. ARS scientists earlier had identified 20 flavor components found in fresh orange juice, and then determined the amount of each in the four main types of orange juice products. They developed a computer program that calculates the proportion of these flavor components in the orange juice products. Citrus processors can use the program to determine how close the flavor of their juice is to that of freshly squeezed orange juice. The program can also show which flavor fractions to add to juice products to make them more nearly match the taste of fresh orange juice.

*U.S. Citrus and Subtropical Products Laboratory
Winter Haven, FL
Philip E. Shaw, (813) 293-4133*

A fatal case of indigestion can await insect pests that gnaw on genetically altered plants. An enzyme in the plants apparently triggers the reaction. ARS scientists discovered this new insect-resistance mechanism. Ohio State researchers genetically modified tomato and tobacco plants to overproduce the enzyme, which causes rapid browning when insects start to damage the plants. ARS greenhouse and laboratory studies found that 90 percent of corn earworms and dusky sap beetles died after feeding on the plants. Researchers suspect the browning enzyme makes plant tissue tougher, indigestible and toxic. Corn earworms infest corn, cotton, tomatoes and other crops, causing an estimated \$1.2 billion in damage each year. Sap beetles reduce yields of fruit and grain crops such as figs, peaches and corn. They also spread unwanted fungi, such as *Aspergillus flavus*, which produces aflatoxin in corn. *Mycotoxin Research, Peoria, IL
Patrick F. Dowd, (309) 681-6242*

Pickle research has given winemakers a new way to test the quality of their wine. Adapted from a method developed to analyze acids and sugars in fresh cucumbers and pickles, the new test allows organic acids, sugars and alcohols to be analyzed simultaneously. Wine taste and quality depend in part on the right mix of these compounds. Winemakers can determine the amount of each compound in their product. But this refined version of a technique called high-performance liquid chromatography is a more accurate and faster way to measure these critical compounds. Also, the new test could eliminate some problems the wine industry encounters when the compounds are considered separately.

*Food Science Research, Raleigh, NC
Roger F. McFeeters, (919) 515-2979*

Australian tobacco plants are yielding natural pesticides against sweetpotato whiteflies and other crop-damaging insects. Of the 17 tobacco species evaluated, researchers found extracts from three species highly effective in killing immature sweetpotato whiteflies, green peach aphids and spidermites that have attacked crops in western states the last couple of years. The most potent was a mixture of four similar compounds of *Nicotiana gossei*--which killed 88 to 94 percent of immature whiteflies in greenhouse tests. A one-percent mixture of the compounds also controlled the greenhouse whitefly and the green peach aphid and prevented the two-spotted spidermite from feeding and reproducing. A one-tenth of one percent mixture in water was as good as, or better than, recommended mixtures of commonly available biocontrol products and pesticides. The purified product was stable for one year. A patent has been granted, and scientists are looking forward to product development.

*Florist and Nursery Crops Laboratory, Beltsville, MD
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Sweetpotato whiteflies would rather eat green than red cabbages. That's true of other cole crops. They also prefer plants that have waxy leaf surfaces, ARS scientists found in studies of plant characteristics that could play a future role in controlling whiteflies. A destructive pest of about 500 crops, the whitefly is resistant to insecticides. Scientists ran small-scale lab and field studies of 70 varieties of cole crops--including kale, collards, cabbage, Brussels sprouts, kohlrabi and broccoli. About 90 percent fewer whiteflies attacked red varieties than green ones. Also, plants with glazed, low-wax leaves attracted fewer flies. That's probably because the lower levels of wax cause are less desirable for laying eggs. Scientists say breeders should take color and levels of leaf wax into account when screening germplasm for breeding varieties resistant to the pest.

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